Feed Forward Approach for Data Processing in IoT over Cloud

B.Mallikarjuna, Anand Dohare, Mhd.Shahajad, Tulika

Abstract*: Combination of Internet of Things and cloud computing is gaining popularity in the present and future scenario, There is a necessity of sensor nodes in IoT environment are fulfilled by the cloud service providers. Integration of IoT with cloud computing is a challenging task, This paper provides integrated architecture of data processing over cloud platform with IoT, in addition to that a feed forward approach for data processing in IoT over cloud was proposed. The feed forward approach has to solve the issues of QoS provisioning, service discovery, energy efficiency and security. The performance of the proposed integrated architecture is tested with Amazon cloud service data set, the results proved the efficiency of the feed forward approach.

Index Terms*: cloud computing, integration of IoT, Feed Forward Approach, QoS, gateway, IoT sensor nodes.

I. INTRODUCTION

The Internet of Things (IoT) consists of Radio Frequency Identification (RFID), internet protocols, smart sensors, communication technologies and it improves quality of human lives [1]. The applications of IoT are transportation, health care, industrial automation, the present revolution of internet is mobile and machine-to-machine (M2M) technologies [1]. The IoT provides significant of human live and quality it deals with business applications and it grow the world economy [2]. Suppose for a example if smart city is made up of IoT then every home will enable their residents to automatically open the door at the entrance when their reaching home, prepare the coffee and breakfast automatically [3]. To perform the climate control system and pervasive and ubiquitous nature it required to support emerging technologies [4]. The emerging technologies which are supporting to IoT are Big data Analytics, Cloud and Fog computing etc. The cloud computing pay as you go model, it consists of millions of data centers and it composed of trillions of virtual machines (VMs). The data centers are performing higher utilization of VMs without degrading the performance. The effective tasks allocation strategy performing on VMs [5].

Internet of Things (IoT) which connects objects either living things or nonliving things are made connect to the internet, cloud computing involves processing data internet to data centers [1,2]. The objects/things it can be communicated through the Radio Frequency Identification Tags (RFID), cloud computing provides services to create IoT applications [3,4]. The objects/things have ability to compute tasks and communicate with internet and provide utilities to the user [5,6]. In this paper focused on three major layers of IoT such as perception layer, network layer and application layer due to huge data transmission that provide efficient communication. There is necessity to design integrated architecture IoT with cloud due to transmission of zetta bytes of data in IoT over cloud[6,7]. In future integrated architecture plays a significant role while millions of devices connected to the internet and communicate through the people [1-7].

The rest of the paper section 2 describes the related work that demonstrates the layered architecture of IoT and integration of IoT with cloud services. Section 3 explains about the feed forward approach IoT over cloud. Section 4 discussed about the results and discussions finally this paper ended with the section 5 conclusion.

II. RELATED WORK

In Figure 1, the layered architecture of IoT is presented three general layers considered for IoT architecture such as perception layer, network layer and application layer, the recent study proposed [8] that there are two additional layers are defined such as middle ware layer and business layer [9].

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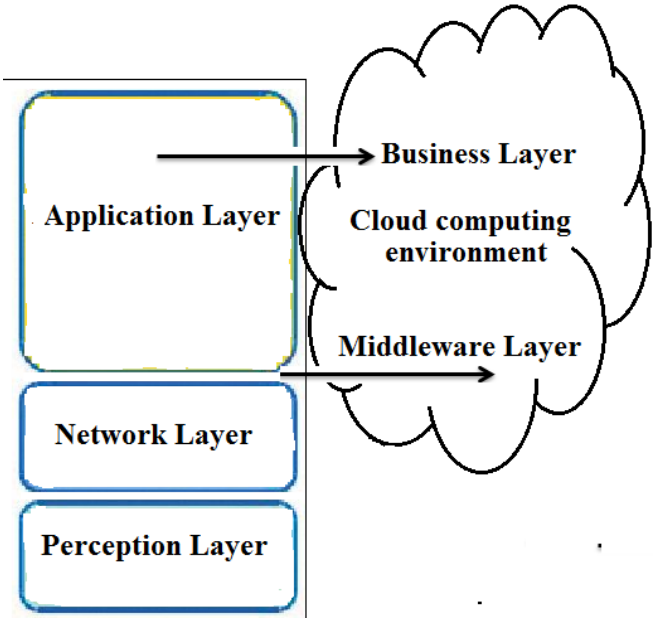

Figure 1: Layered Architecture of IoT [8]

Perception Layer: This is first layer of the three layered architecture, this layer act as the sensing layer of IoT and gather the data. It contains RFID tags, monitoring sensors

The main functionality of this layer gather the data and transfers through the network layer through the secure channels.

Network Layer: This layer transfer the data from perception layer and sends data to the internet. This layer embedded with two layers network layer and transport layer. The major functionality of this layer contains gateway which transform the data between internet and perception layer.

Application Layer: This layer obtains the data from the network layer and provides the data to application. That provides an environment of the services requested by the customer.

Middleware Layer: This layer lies in between network layer and application layer, this layer gather the information from the network layer and store or process the information. This layer having decision whether data has to be forwarded to the application layer or automatically process the information.

Business Layer: The business layer is also called as management layer it manage the overall system activities and services, this layer builds the responsibility of the business model such as graphs, statistical analysis etc. it receives the data and process the data based on the big data analytics and making decisions.

2.1 Communication between IoT over cloud services

There are several studies has been made [8-12], cloud computing required very huge amount of data storage and data processing, there are billions of devices are connected to the IoT for data processing [9]. The cloud provide the services to IoT which are integrated with sensor nodes [10], The integrated architecture of IoT with cloud services as shown in Figure 2 [11,12].

Figure 2: Integrated architecture of IoT with cloud services [9-12].

Edge Computing/Edge Analytics [9] is a relatively new approach for many companies. Most of the architectures are used to sending all data to the Cloud/Lake [8-10]. But in Edge computing, that does not happen. i.e, data can be processed near the source and not all data is sent back to the Cloud [9]. For large-scale IoT deployments, this functionality is critical because of the sheer volumes of Data being generated [8-12].

Integration of IoT with cloud services is a challenging task, IoT does not allow all things to integrate and allow to utilize cloud resources. Nef,M.A. etc. al.(2011) , Duan etc. al.(2012) proposed QoS provisioning policy on integrated architecture of IoT with cloud, In this architecture cloud necessity to generate prioritization of data [13]. In this architecture data size is proportional to the sensor nodes , the QoS is a major issue for sensor nodes produce data at any time [13]. Sheng etc. al. (2013) and Zanella etc. al. (2014) they proposed integrated architecture of IoT with cloud but they focused on protocol design [12].

In IoT some devices supports Zigbee protocol and some devices supports IEEE 802.11 protocol, gateway is exist between IoT and applications of cloud services [14]. There is no guarantee for protocol if there is new sensor is added in this approach[12,14].

Misra.s, P.V Krishna, M. Obaidat etc. al. (2011) proposed a learning automata based solution for distributed denial of service in IoT, in this paper resource allocation is the major issue on integrated architecture of IoT with cloud platform, It is not provide strong support for resources to the IoT without knowing the exact utilization [15]. P.V Krishna etc. al. (2014) secure socket layer certificate verification focused on energy efficiency on IoT environment must connected to the cloud, all sensor devices are connected to the sensing unit,

processing unit, power supply unit for data processing on cloud [16]. Most of sensor units are operated with limited power supply on IoT, till there is a efficient mechanism is need for efficient utilization of cloud services. Service discovery is the major issue integrated architecture of cloud, in IoT any node can join and leave in the network, hence there is a need for continuous monitoring and IoT manager is also needed to manage the services [15,16,18]. Baber et. al. (2010) proposed security model and threat taxonomy for IoT , the combination of IoT with cloud privacy and security is the major issue, the produced from the sensor nodes is a confidential and requires some security mechanism [17].

III. FEED FORWARD APPROACH FOR DATA PROCESSING

In IoT environment the things can communicate to the user and provide the services, it required QoS provisioning, protocol design, resource allocation, energy efficiency and service discovery and privacy and security. There is a necessity to design integrated architecture IoT over cloud. In IoT anything can communicate to the cloud there is a need of anything can upload to the internet or stop nodes to gather the information, there is a significant importance of gateway. The gateway having decision forward approach. The Figure 3 described that integrated architecture of IoT based cloud. The algorithm1 describes in detail flow of the integrated architecture of data processing IoT over cloud.

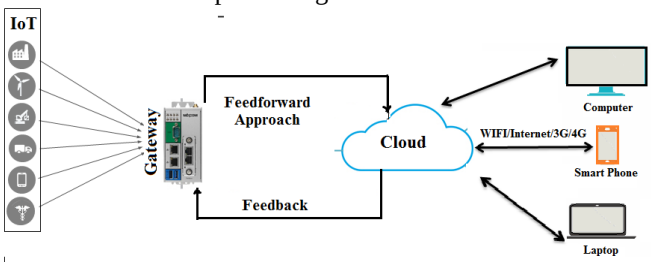

Figure 3: Feed forward approach for IoT over Cloud

Some of the companies Cisco, Intel etc. are supported and implemented IoT by putting the gateway in between the edge devices and provide the services over cloud. The basic functionality of gateway is traffic aggregation and routing. Gate ways are not only route the data but also store data and perform computations on the data. The responsibilities of gateways are preprocessing or filtering of the data where the received and where the data is processed. The gateway has to manage different services such as reduce the energy consumption of nodes, managing the sensors and maintain security of the data. The gate way has to analyze the data and process the feedback to make decision to forward data to the cloud or restrict the data to the based on the feedback approach generated by the cloud.

Algorithm 1: Feed forward Approach for Data Processing IoT over Cloud

Step 1: Initialize the sensor nodes at IoT environment
Step2: Sensor nodes gathers the data and forwards to the gateway
Step 3: Gateway forwards the request message to the application where it is deployed in the cloud
Step 4: Applications responds with a feedback about the timestamp of the data required
Step5: Gateway collects the data at particular time requested by the application and forwards to the cloud
Step6: The smart user can access the data any time that are stored in the cloud

Here gateway has to manage different services like gathering the data from the sensor nodes. To address aforementioned issues to maintain the layers of gateway as follows as shown in Figure 4.

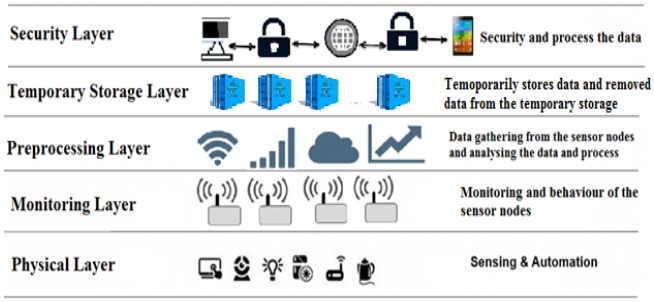

Figure 4: Layered architecture of gateway

The layered architecture of gateway performs QoS provisioning, protocol design, resource allocation, energy efficiency, service discovery, privacy and security as follows

Physical layer: In this layer perform the sensing automation and perform key enable 5th generation of wireless connectivity among IoT devices, the sensor nodes are connected to the virtual nodes and virtualization network.

Monitoring layer: The monitoring layer operates power, resources, responses and services and it major focus of the sensor nodes to obtain minimum energy consumption.

Preprocessing layer: This layer continuously process the data and gathering the data from sensor nodes, remote data gathering from the remote sensor nodes, sensors are connected remotely, it retrieve the data from the cloud services , it is easy to read the data from our web portal, filtering the data and analytics of the data, and finally preprocessed data is generated.

Temporary Storage Layer: This layer store the data and gather from the nodes temporarily data replication, distribution and storage. Once stored data is uploaded to the cloud it removed the temporary storage device.

Security Layer: This layer operates encryption and decryption operations in IoT over cloud, it ensure the data generated by the sensor nodes and provides integrity and privacy.

IV. RESULTS AND DISCUSSIONS

The proposed architecture has been tested with the energy consumption of the sensor nodes and it is evaluated with the Amazon EC2 cloud service, the data set model is considered to be Stanford lorge network dataset collection [snap.stanford.edu] it consider four temperature sensor nodes . The gateway configured with the sensor nodes and cloud platform.

The Figure 5 illustrated that energy consumption of the sensor nodes feedforward approach and without feedforward approach. The feed forward approach request the data at particular time hence the energy consumption of the nodes will be reduced automatically.

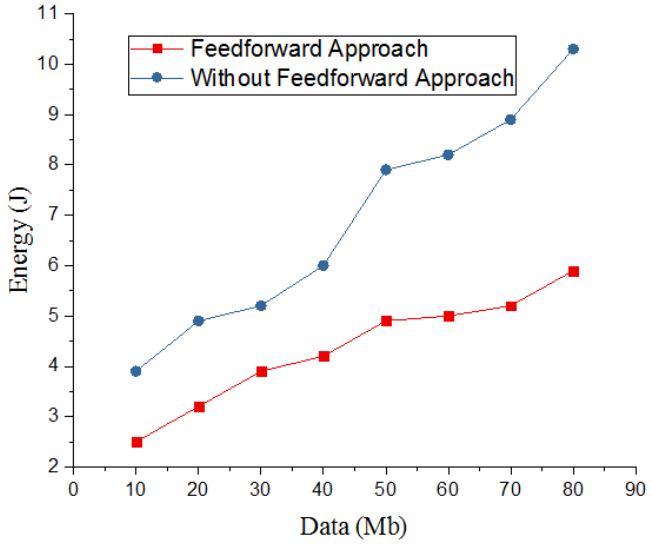

Figure 5: Energy consumption of the sensor nodes

The comparison of the service discovery of the sensor nodes, the data set has been considered from standford university it maintain amazon dataset it consists data span from past 18 years. The feedforward approach is compared with the service discovery of sensor nodes with feed forward approach and without feed forward approach, the feed forward approach less than without feed forward approach. The gateway is monitoring the services regularly as shown in Figure 6.

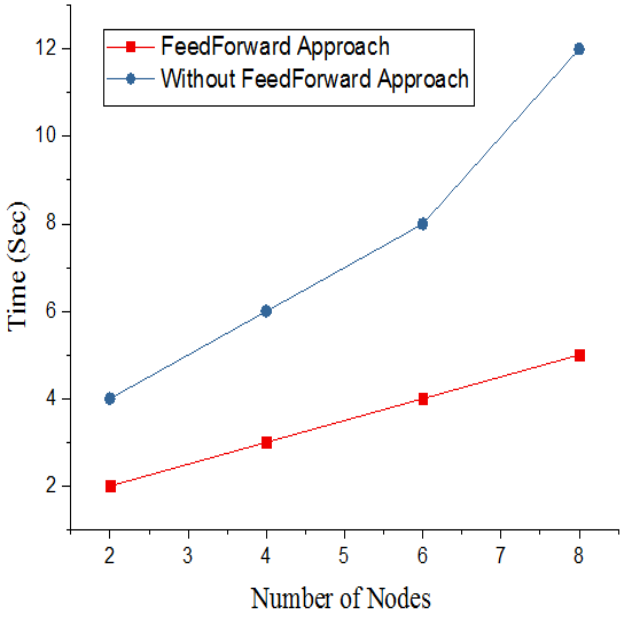

Figure 6: Service discovery of sensor nodes.

V. CONCLUSIONS

This paper proposed the feed forward integration approach of IoT for efficient communication over the cloud and IoT environment. The paper focused on feed forward approach integration of IoT and cloud services, the proposed architecture improves the layers of gateway for efficient processing of data to the cloud. The performance of the proposed architecture is tested with the energy consumption and service discovery of the sensor nodes. The result of the proposed architecture proved that efficiency of the feedforward approach. In future there is a scope to describe the proposed model to develop the health care applications and smart home applications etc.

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